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1979
ENVIRONMENTAL MONITORING
REPORT

U.S. DEPARTMENT OF
ENERGY FACILITIES
GRAND JUNCTION, COLORADO
AND MONTICELLO, UTAH

PREPARED BY
BENDIX FIELD ENGINEERING CORPORATION
SAFETY OFFICE

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THE GRAND JUNCTION, COLORADO, DOE FACILITY

1.0 Present Environmental Status of the DOE Facility

1.1 Generation of Potential Air Contaminants

1.1.1 Mineral Solids from the Sample Plant

The Sample Plant receives a continuing input of mineral samples for preparation and geological assessment. These minerals are usually not ore samples but simply specimens representative of the geology of various regions. Therefore, their level of radioactivity is low, and their principal environmental interest is in relation to potential dust hazards.

Sample preparation includes crushing and grinding, and all such operations are air-blanketed and are vented through the exhaust system to a baghouse. At peak rates of operation, the baghouse will collect sufficient dust to fill about two barrels (55 gallons) per year. Since baghouse filters of this type are at least 99% efficient, the potential air pollution from dusts in the Sample Plant is negligible.

The air ducts of the Sample Plant are cleaned once a year to preclude mineral concentrations from collecting in the low spots and stagnant pockets of the ductwork. At present, all solids collected from the baghouse are stored above ground in the barrels that were employed for their collection.

1.1.2 Aerosols from the Analytical Laboratory

The Analytical Laboratory at the DOE facility performs chemical analysis of various types, in support of the overall mission of the facility. More than 90% of these analyses are mineral assays that involve acid digestion of the minerals to yield metallic solutions. An average of 9,500 analyses of this type are now conducted each month.

These digestions are conducted in any one of five ventilated hoods. Many of these digestions involve a minor quantity of hydrofluoric acid (HF) for the purpose of dissolving the silica that is present in the minerals. The other acids in these digestions (including sulfuric, nitric, hydrochloric, and perchloric acids) are corrosive but not sufficiently toxic to present health

hazards, but rather a nuisance, in the minor airborne concentrations resulting from laboratory digestions. New fume hoods with vent scrubbers (water type) are presently being installed which will virtually eliminate these nuisance vapors from being vented into the atmosphere.

1.1.3 Emissions from Combustion: Automobiles, Heating Plant

Automobiles: The automobiles that deliver the effective population of 550 persons to the DOE facility do not present a source of air pollution that is objectionable by present air quality definitions. The principal air pollutants emitted by automotive sources are carbon monoxide, nitrogen oxides, and unburned hydrocarbons (in that order), and the Ambient Air Quality Standards of the U.S. Environmental Protection Agency (EPA) for these pollutants are as follows:

Carbon Monoxide	9 ppm	8 hr. avg.
	35 ppm	1 hr. avg.
Nitrogen Oxides	0.05 ppm	Annual Avg.
Hydrocarbons	0.24 ppm	3 hr. avg.

The daily automotive activities within the facility, even during periods of construction and enhanced activity, do not cause these levels of air pollutants to be exceeded.

Central Heating Plant: The Heating Plant includes two main steam boilers: a Babcock and Wilcox boiler rated at 17,250 lb/hr and a Keeler boiler rated at 23,700 lb/hr. Two small package boilers are also available for use in periods of minor heating requirements. When both the large boilers are operative at full load at the same time, they will generate approximately 41×10^6 BTU per hour, and will produce about 0.2 lb/hr (0.03 g/sec) of nitrogen oxides (NO_x) in the stack gas.

This level of NO_x in the stack gas will not cause significant enhancement of ambient NO_x concentrations in the ambient air beyond a radius of about 5 x meters from the stack emission point except under extreme conditions of air stability. The Central Heating Plant emits no other air pollutants in significant quantities.

Other Sources: Other minor combustion points at the facility (individual building boilers, hot water heaters, etc.) produce negligible quantities of air pollutants. Government installations are increasingly being encouraged to consider the use of fuels other than natural gas. If either oil or coal is substituted for natural gas, emissions of air pollutants will rise sharply.

1.1.4 Radon and Daughter Products and External Gamma Radiation

The Grand Junction DOE facility has, in the past, been the site of a pilot plant, sampling and storage of uranium oxide (yellowcake). As a result, there is a potential for site contamination by uranium and its decay products, including radon gas. Contaminated equipment and physical facilities also present the opportunity for exposures to elevated gamma radiation from radioactive decay.

Locations where possible radioactive discharge are emitted to the atmosphere are the chemical laboratory, building 20, the sample preparation operations, building 7, and the tailings burial site. The calculated amounts for these locations are as follows:

Chemical Laboratory, Building 20	Nil (less than 1 microcurrie per year)
Sample Preparation Laboratory, Building 7	1.3×10^{-8} microcurrie/ml/min

Tailings Site: In previous times, 30,000 tons of uranium mill tailings of varying activities, together with contaminated equipment, ore samples, and other solid wastes were buried in pits constructed in the alluvium a short distance north (downgradient) of the previously mentioned lagoon. The strength, concentration, and mobility of much of the material buried is incompletely known.

Subsurface water sampling wells (2) have been installed (refer to appendix 3.1), one each downgradient of the lagoon and the tailings site. Sampling of these wells was accomplished in January, 1980, and reflect some migration of radionuclides (refer to appendices 3.2 and 3.3).

There are no buildings on or operational activities conducted within the tailings burial site of the Grand Junction Facility.

Twelve radon flux measurements were made within the tailings site on May 30, 1979. These measurements were performed by using M-11 charcoal-filled gas mask canisters that were placed on the soil for 5 hours.

The values of the flux measurements are shown in appendix 3.4 and the locations are shown in appendix 3.5. Measurement locations were chosen after a preliminary gamma survey was conducted to locate elevated areas of gamma radiation.

In January, 1980, a metal fence was installed around the tailings burial site, and appropriate warning signs attached, to specifically define the area.

Exposure levels in various offices within the DOE facility were measured in 1972. This was during a period of extensive yellowcake storage at the facility, and expected present levels should be lower than levels measured at that time. The 1972 data indicate that external gamma radiation levels were generally low.

Another radiometric survey of the facility, including all buildings, is now in progress and scheduled for completion during May, 1980. The results of the new survey will be incorporated into the next environmental monitoring report.

1.2 Sanitary and Process Waste Water Management

1.2.1 Waste Water Discharges and Treatment

All sanitary waste waters from buildings at the DOE facility are passed through septic tanks before discharge to impoundments.

There are presently 20 septic tanks in active service, distributed as follows:

<u>Building</u>	<u>Function</u>	<u>Septic Tanks</u>
1	Central Heating Plant	1
2	Offices	1
6	Printing & Duplication	1
7, 47	Offices	1
7A	Sampling Plant	1
8	Offices	1
9, 38, 45	Offices	1
10	Offices	1
11	South Gate House	1
12	Offices	1
12A	Offices	1
18	Library, Offices, Credit Union	1
19	North Gate House	2 in series
20	Analytical Laboratory	1
22	Offices	1
26, 48	Offices	1
28	Shop Building	1
30	Laboratory Offices	1
45	Offices	1
46	Cafeteria	<u>1</u>
		Total 20

There are four additional septic tanks in the storage and disused areas that include buildings 31 through 36, but these septic tanks receive practically no loadings at the present time. All septic tanks, overflow to the sewage treatment lagoon except those serving buildings 7, 7A, 11, 18, 19, and 47. These septic tanks discharge to the following points:

Buildings 7, 18, 19, 47	Groundwater pond north of the compound
Building 7A	Low ground at the north end of compound (within fence)
Building 11	Receiving well near the building

The only significant process liquid wastes discharged at the DOE facility are intermittent releases of acid solutions and organic solvents from the Analytical Laboratory (buildings 20,20A). These liquid flows are discharged through the acid drain line directly to the sewage lagoon without treatment. Approximately 25% of all storm water falling upon the compound is directed to the sewage lagoon by means of catch basins and drain lines at the higher elevations on the grounds. The remainder of storm waters are directed to the groundwater pond at the north end of the facility by means of catch basins and drain lines. Assuming that 80% of sanitary waste waters from a total effective facility population of 550 persons are sent to the sewage lagoon after septic tanks treatment, plus storm waters from 25% of the facility acreage, the total loads to the lagoon and the groundwater pond may be summarized as follows:

1) Sewage Lagoon

Sanitary sewage:	Flow=(0.8) (GPCPD) (P) = 11,000 gal/day
	Load=(0.8) (BODPCPD) (P) = 75 lb BOD/day
Storm waters:	Flow=(7.5) (A) (AAP)/(365) (12) = 2,840 gal/day

2) Groundwater pond

Sanitary sewage:	Flow=(0.2) (GPCPD) (P) = 2,750 gal/day
	Load=(0.2) (BODPCPD) (P) = 19 lb BOD/day
Storm waters:	Flow=(7.5) (A) (AAP)/(365) (12) = 700 gal/day

Where A = surface receiving precipitation = 200,000 sq. ft. for lagoon, 50,000 for pond

AAP = average annual precipitation = 8.3 in/yr

BODPCPD = lb BOD per capita per day = 0.17 lb/cap/day

GPCPD = gallons per capita per day = 25 gal/cap/day

P = effective facility population = 550

Values for BODPCPD and GPCPD are those which are widely used in standard texts and by regulatory agencies, while the annual precipitation was taken from compilations of the American Society of Heating, Air Conditioning, and Refrigeration Engineers (ASHRAE).

Sewage Lagoon: The sewage lagoon has a surface area of about 37,000 sq. ft. and a design volume of about 1,070,000 gallons. Maximum depth is about 4 feet. Therefore the lagoon has an average design detention time of about 70 days, and the detention time would exceed 5 days even when one inch of rainfall was experienced in a single event. There are no State of Colorado standards for unaerated waste stabilization ponds, but the document entitled "Criteria Used in the Review of Waste Water Treatment Facilities" (1973) states: "It is very doubtful that unaerated waste stabilization ponds can meet the effluent standards for discharge." The usual detention times for unaerated ponds vary from 5 to 50 days, and by this yardstick the sewage lagoon at the DOE facility is typical of usual practice. On an acreage basis, the lagoon is loaded at the rate of about 88 lb. BOD per acre per day, which is relatively high for a lagoon of such shallow depth. (Lagoons 3 to 8 feet deep are typically loaded at the rate of 20-50 lb. BOD per acre per day).

1.3 Surface Water

The DOE Grand Junction compound is located on a bend of the adjacent Gunnison River, a major stream of western Colorado. Water-borne wastes from the compound would be expected to reach the Gunnison via subsurface seepage. Because of the dilution available in the stream, it is difficult to imagine activities within the compound causing a detectable impact on the Gunnison River.

All present or potential point-source discharge of waste to a navigable waterway requires a discharge permit under the National Pollutant Discharge Elimination System (NPDES), created under the requirements of the Water Pollution Control Act Amendments of 1972 (P.L. 92-500). While there is currently no discrete discharge of waste from the existing sewage lagoon, a potential for such a discharge exists, and upgrading of the system will decrease the likelihood of such a surface discharge.

1.3.1 Groundwater

As stated above, the DOE Grand Junction facility is located adjacent to the Gunnison River. It occupies a stream terrace underlain by alluvium deposited by the river. Groundwater in the alluvium is connected to the Gunnison River, with general groundwater movement under the compound toward the north. Liquid

wastes discharged by the facility and percolating precipitation would enter the groundwater body and move toward the north.

Liquid waste from the sewage system of the DOE compound is discharged to the septic tanks located adjacent to the various buildings. Overflow from the septic tanks either discharges into a collection system which drains into a small (37,000 sq. ft.) lagoon, 4 feet deep, excavated into the alluvium or into the north ponding area. The lagoon receives all Analytical Laboratory wastes from water and chemical analyses conducted within the compound. (See 1.2.1, above).

It is reasonable to expect that many of the chemicals discharged either directly to the lagoon or indirectly through the septic tanks will end up in the groundwater underlying the DOE compound.

1.4 Gunnison River

The Gunnison River was evaluated for possible contamination by the Department of Energy's Grand Junction Operations. Samples of river water and sediment were collected during January of 1980. These samples were analyzed for a variety of chemical species chosen because of their known or suspected disposal near the river bed.

Samples of river water were collected both up and downstream from the compound (refer to appendix 3.1). Contamination from the compound would have been demonstrated if the concentrations of chemical species were greater in the downstream sample. Instead, the upstream concentrations were either larger or within experimental error of those downstream (refer to appendices 3.6 and 3.7). Apparently, none of these species were being leached into the river in detectable quantities at the time of sampling. However, this was a period of high water when dilution of pollutants would be very great. Consequently, this evaluation will be repeated in late summer during low stream flow. In addition to the upstream and downstream sites, a sediment sample was taken alongside the most likely sources of contamination from the compound. Again, no contamination was shown by the analytical results. Unfortunately, sample collection was hampered by the high water. For this reason, a more extensive sediment sampling program is also planned for late summer.

The possibility of contaminating the river in the future was studied by analyzing water and sediment samples from the known waste sites within the compound. As expected, several substances were present in greatly elevated concentrations. The discharge of these wastes directly or indirectly (i.e. through groundwater) into the river system would be clearly prohibited by state and federal statutes.

Samples of water and sediment were taken to determine whether there has been contamination of the river by the DOE-GJO operations. Leaching occurring at this time should be apparent in the water analyses.

Septic wastes are not currently affecting the river as shown by the following data:

	<u>Coliform</u> <u>Counts/100 ml</u>	<u>Organic</u> <u>Carbon</u> <u>mg/l</u>	<u>NH⁴-N</u> <u>mg/l</u>	<u>NO³-N</u> <u>mg/l</u>	<u>NO²-N</u> <u>mg/l</u>
Gunnison River					
Upstream	1500	11	<.5	.7	<.01
Gunnison River					
Downstream	1300	3	<.5	.9	<.01

The upstream concentrations are all larger or within experimental error of those downstream. As a point of reference, the Colorado River has a coliform count of 2000/100 ml where Clifton, Colorado, takes its' water supply. Appendices 3.6 and 3.7 display the data for certain inorganic species that might be leached from the compound as well as ph, alkalinity, and conductivity. Once again, there are no significant differences between the upstream and downstream samples.

2.0 Environmental Regulations Applicable to the DOE Facility

2.1 Air Emissions Requirements

Apart from the National Ambient Air Quality Standards published by the EPA (Section 1.1.3 above), the State of Colorado has adopted detailed requirements for the control of emissions of particular air pollutants. These requirements

are compiled in Regulation #8 of the Colorado Air Quality Standards, dated April 5, 1975, as amended.

The only significant air pollutant generated on a continuous basis by the Grand Junction facility is nitrogen oxides (NO_x). The maximum heat emission rate of the Central Heating Plant places the facility (Section 1.1.3 above) in the category of 1,000 to 10,000 kcal/sec, which implies an effective plume rise of $h=54$ m. From Table 1-A of this regulation, the "A" factor for use with the threshold limit value (TLV) is found, and the allowable emission rate is: Allowable Emission Rate = (A) (TLV) (EF) where EF is the "excursion factor" which is unity for NO_x so that allowable emission rate = (A) (TLV) = $(5.0) (9) = 45$ g/sec which is much greater than the estimated rate of NO_x production as given in Section 1.1.3 above.

2.2 Waste Water Discharge Regulations

The Federal Water Pollution Control Act Amendment of 1972 established the National Pollutant Discharge Elimination System (NPDES), and made it illegal to discharge pollutants to navigable waters without an NPDES permit. Rulings have held that wastes will reach such waters. The program is administered in Colorado by the Colorado Department of Health, which reviews and passes on all permit applications.

The Resource Conservation and Recovery Act (RCRA) which became law in 1976 has a two-fold approach. First, all solid waste disposal sites are defined either as open dumps or sanitary land-fills. The former must be closed or upgraded to the latter within five years. The distinction is based on whether or not sites meet minimum criteria (to be promulgated) which will include control of leachates, monitor wells, etc. Second, hazardous wastes (to be defined broadly by the EPA) will be subject to a "cradle to grave" manifest system for responsibility control. A lagoon such as the one at the Grand Junction DOE facility would become a solid waste disposal site, and it would not meet the criteria.

The Safe Drinking Water Act provides for a state/federal program to control the subsurface injection of wastes (UIC). To date, this has been defined on the basis of well injection, but the legislation is sufficiently broad to

permit control of injections from "pit, pond, and lagoon" seepage, and there is a strong move to expand regulations to cover such sources.

The State of Colorado has now adopted the final version of its Water Quality Standards for Colorado, which is now in press after passing through ten drafts. Effluent limitations for point sources are specified in the "Regulation for Effluent Limitations" (effective August 21, 1975), which comprises the effective specifications to accompany the Colorado Water Control Act (July, 1975). Also in effect are the "Amendments to Regulations for the State Discharge Permit System" (as amended February 7, 1978).

2.3 Process Waste Liquid Management

There are no specific regulatory restrictions on process waste liquids at the present time. The most influential publication on this subject has been Water Quality Criteria, first published in 1963 by the California State Water Quality Control Board (J. E. McKee and H. W. Wolf, authors) and continued by the Environmental Protection Agency as Water Quality Criteria 1972, publication EPA-R3-73-033. These criteria should be especially interesting to the Grand Junction facility for their consideration of heavy metals. The mineral solutions discharged by the DOE facility (especially from chemical analyses) will not affect waste water treatment unless they are massive releases. The most recent (5-15-79) evaluation of heavy metals discharge indicates a very small (negligible) amount and would not contribute a detectable increase in the normal waste discharge (refer to appendix 3.8). The organic solvent discharges from the Analytical Laboratory likewise will not affect treatment significantly unless they form aeration-inhibiting films on the surface of the treatment lagoon, but they will also probably be classified as "hazardous wastes" in the future (refer to appendix 3.9). The photographic laboratory in its operation utilizes certain photochemicals in the film developing and reproduction processes. The effluents from film processing primarily consists of a "developer" which is moderately alkaline and a "fixer" which is moderately acidic. The wash water is essentially unchanged from that of the incoming water supply. During the process silver halides are extracted from the film and paper by the fixer, as a soluble silver thiosulfate complex. This complex is dramatically less toxic than free silver ion. However, the

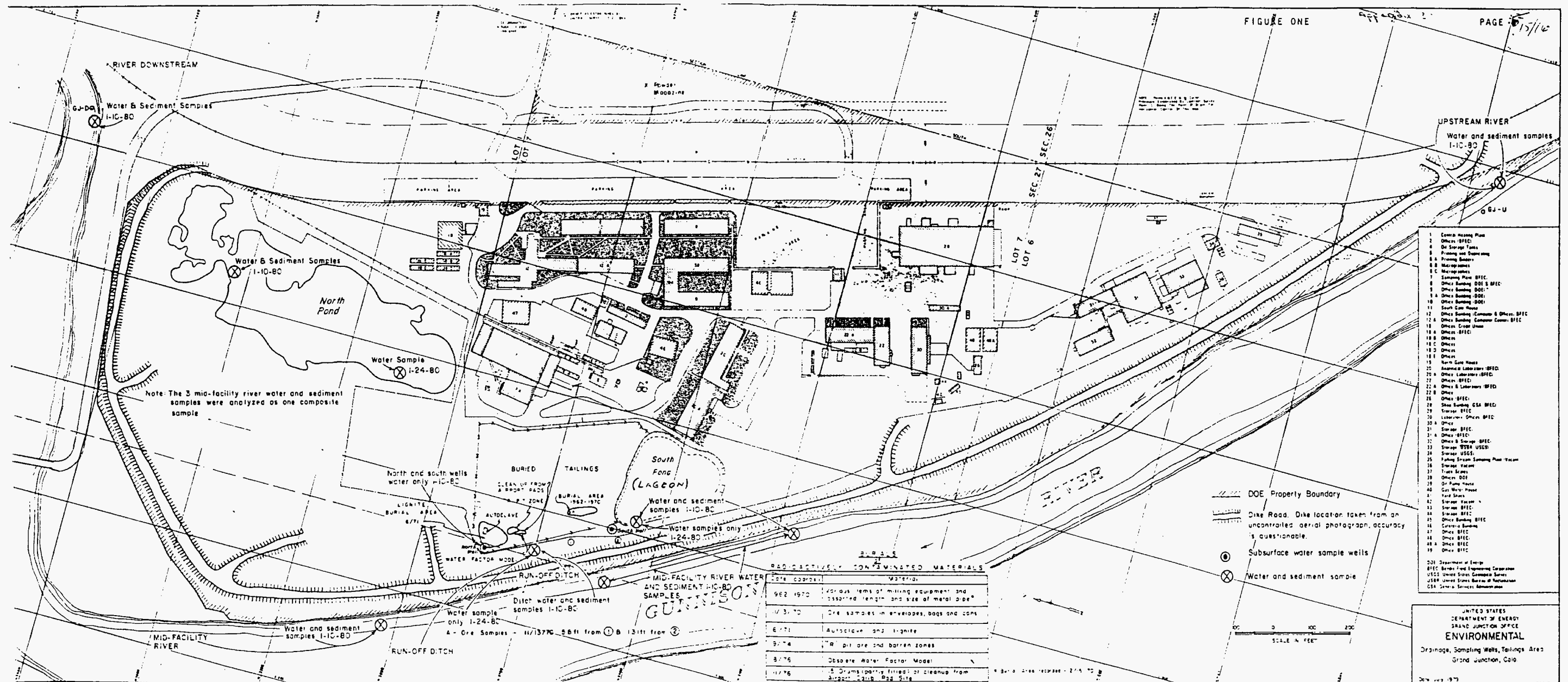
silver is recovered from the fixer solutions via an electrostatic silver recovery unit and returned to the film supplier for reprocessing.

The ratio of "wash solution" is approximately 50 to 1 of the process solutions that are utilized. Refer to appendix 3.10 for a list of presently used chemicals and their respective disposal methods.

2.4 Solid Waste Management

On October 26, 1976, Congress passed the Resource Conservation and Recovery Act (RCRA) as a series of amendments to the existing solid waste control act. This legislation and resultant regulations will have a significant impact on the operation of the DOE Grand Junction Facility. The act defines "solid waste" as solid, semi-solid, liquid, or contained gaseous wastes. The act recognizes only two classes of solid waste disposal sites: open dumps and sanitary land-fills. The former must be upgraded or closed within five years.

3.0 Appendices



pendix 3.2

Analytical Results from Waste Sites and Test Wells - Waters

	pH	Conductivity μmhos/cm	Alkalinity mg CaCO ₃ /l	mg/l AG	mg/l Al	mg/l As	mg/l Ba	mg/l Be	mg/l Cd	mg/l Cl	mg/l Cr	mg/l Cu	mg/l F	mg/l Fe	mg/l Hg
North Pond	7.5	20900	470	.004	.023	.004	<.1	<.0002	<.5	385	.011	.005	<1	0.1	<.0001
South Pond	7.3	21800	361	.002	1.18	.002	.1	.0002	<.5	135	.004	.012	<1	1.2	.0001
South Well	7.3	18750	1359	.0003	3.4	.213	1.3	.005	3	160	.034	.018	<1	23.7	<.0001
North Well	7.1	23500	1138	.0002	8.3	.343	.4	.005	5	110	.016	.15	<1	18.3	<.0001
Drainage Ditch	6.9	23000	305	.005	.72	.003	<.1	.0002	.5	82	.005	.016	<1	1.1	.0002

	mg/l Mn	mg/l Ni	mg/l NH ₄ -M	mg/l NO ₃ -N	mg/l NO ₂ -N	mg/l Se	mg/l So	mg/l Th	mg/l U ₃₀₈	mg/l V	mg/l Zn	mg/l Organic Carbon	100 ml Coliform Counts	pCi/l 226Ra
North Pond	.35	.006	1.5	.32	.03	<.001	2200	<.05	.32	.025	.01	3	0	<.5
South Pond	.26	.011	17	.02	.02	<.001	72	<.05	.005	<.01	.06	16	24,000	13.2
South Well	7.1	.04	5	47	.1	<.001	37	<.05	1.53	3.9	.52	7	1,000	565
North Well	6.5	.04	2.5	.28	<.01	<.001	330	<.05	.53	.7	.34	8	400	9.3
Drainage Ditch	.26	.011	14	.20	.02	<.001	75	<.05	.006	<.01	.06	24	>24,000	16.4

Appendix 3.3

Analytical Results from Waste Sites and Test Wells - Sediments

	ppm Ag	% Al	ppm As	ppm Ba	ppm Be	ppm Cr	ppm Cu	% Fe	ppm Hg	ppm Mn	ppm Pb	ppm NO ₃	ppm Ni
North Pond	2	3.64	8	275	<2	23	17	2.4	.05	860	171	<1	39
South Pond	4	4.15	10	750	<2	16	49	2.2	.12	380	100	<1	39
South Well*	.01	-	.3	2	2	.4	2	-	-	.7	.2	-	.5
North Well*	.002	-	.3	3	6	.4	.2	-	-	1.6	.1	-	.3
Drainage Ditch	14	6.78	59	520	2	49	620	2.3	1.2	160	14	<1	11

	pCi/g ²²⁶ Ra	% S	ppm Se	ppm Th	ppm U ₃ O ₈	ppm eU ₃ O ₈	ppm V	ppm Zn
North Pond	3.8	.81	2	3	21	11	115	72
South Pond	25.3	.18	3	9	57	87	90	84
South Well*	-	-	.07	-	-	-	3	.4
North Well*	-	-	.02	-	-	-	.8	.5
Drainage Ditch	520	.58	22	10	323	1792	340	188

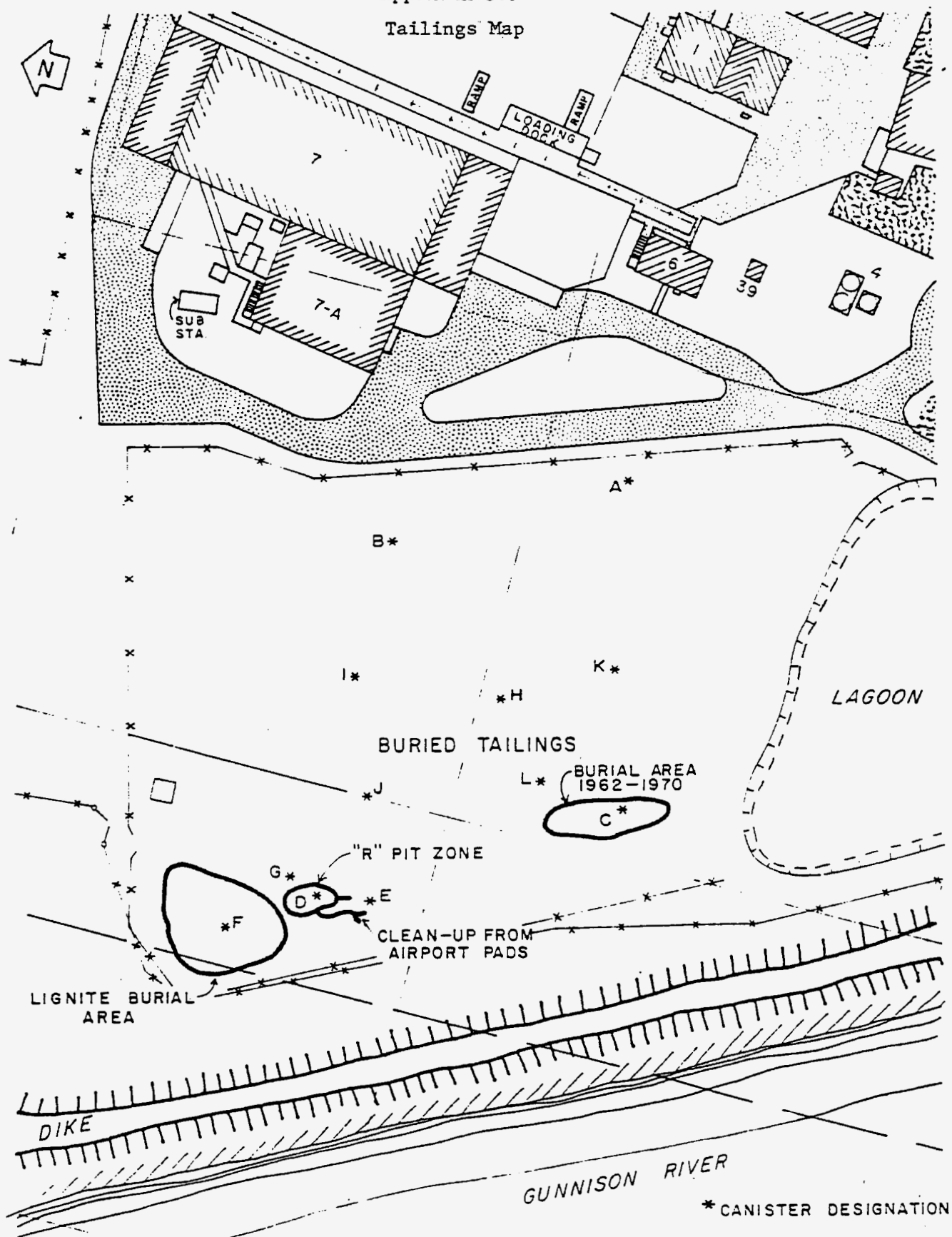
*These analyses are of sediment suspended in the water samples taken from each well. These samples were obtained by passing the samples through 0.45 membrane filters and dissolving the samples. The analyses are reported as ppm of solution, not of solid.

Appendix 3.4

Radon Flux Measurements

<u>CANISTER</u>	<u>LOCATION</u>	<u>FLUX</u> <u>pCi/m²-S</u>
A	E of tailings, 30 ft W of road	50.2 ± 3.2
B	E edge of tailings, on berm. 50 ft W of road	106.6 ± 4.2
C	Center of 1962-1970 burial area	25.3 ± 2.8
D	"R"pit zone	10.3 ± 2.4
E	Airport pad cleanup area	3.1 ± 1.4
F	Lignite Burial area	47.1 ± 3.4
G	Among buried barrels, 10 ft N of D	4.6 ± 1.4
H	On berm, center of tailings area	20.7 ± 2.7
I	NE quadrant at tailings area	70.1 ± 4.1
J	NW quadrant of tailings area	52.0 ± 3.6
K	SE quadrant of tailings area	45.2 ± 3.5
L	SW quadrant of tailings area	64.0 ± 4.0

Appendix 3.5
Tailings Map



US DOE FACILITY GRAND JUNCTION, COLORADO

DIX 3.6

pH Conductivity and Selected Inorganic Species in Gunnison River Water

	pH	Conductivity μ mhos/cm	Alkalinity mg CaCO ₃ /l	mg/l Ag	mg/l Al	mg/l As	mg/l Ba	mg/l Be	mg/l Cl	mg/l Cd	mg/l Cr
Gunnison Upstream	7.8	19500	260	<.0002	1.2	<.002	<.1	<.0002	11	<.0005	.002
Gunnison Downstream	7.8	19500	255	<.0002	1.0	<.002	<.1	<.0002	12	<.0005	.001

	mg/l Cu	mg/l F	mg/l Fe	mg/l Hg	mg/l Mn	mg/l Ni	mg/l Pb	mg/l Se	mg/l SO ₄	mg/l Th	mg/l U ₃ O ₈	mg/l V	mg/l Zn	pCi/l 226Ra
Gunnison Upstream	.037	<1	.43	<.0001	.14	.005	.002	.002	390	<.50	.007	<.01	.01	.1
Gunnison Downstream	.007	<1	.32	<.0001	.11	<.005	.001	.002	390	<.05	.007	<.01	.005	.1

Appendix 3.7

Analyses of Sediment Samples - Gunnison River

	ppm Ag	% Al	ppm As	ppm Ba	ppm Be	ppm Cr	ppm Cu	% Fe	ppm Hg	ppm Mn	ppm NO ₃
Gunnison Upstream	.5	5.2	6	700	<2	26	22	3.1	.03	560	<1
Gunnison Middle	<.5	4.5	4	1000	<2	24	18	2.6	.03	460	<1
Gunnison Downstream	<.5	3.8	3	1600	<2	31	16	6.9	.03	1020	<1

	ppm Ni	ppm Pb	P/Ci/g ²²⁶ Ra	% S	ppm Se	ppm Th	ppm U ₃ O ₈	ppm eU ₃ O ₈	ppm V	ppm Zn	ppm Zr
Gunnison Upstream	20	20	2.4	.06	<1	16	6	8	110	108	429
Gunnison Middle	15	30	1.4	.07	<1	11	8	5	105	104	529
Gunnison Downstream	15	40	1.4	.88	<1	23	8	5	165	114	600

Appendix 3.8
Heavy Metals Discharge

SELECTED ELEMENTS

Except for uranium, only a very small percentage of the samples dissolved at Geochemical Analysis Department (GAD) are actually analyzed for these elements. Therefore, the following values had to be based on estimates of the average content in samples dissolved at GAD.

<u>ELEMENT</u>	<u>YEARLY DISCHARGE (grams)</u>
Uranium	4
Arsenic	2
Selenium	0.01
Molybdenum	0.1
Vanadium	16
Cadmium	0.01
Copper	3
Lead	2
Radium 226	1 x 10 ⁶ *

* Based on uranium results assuming secular equilibrium.

APPENDIX 3.9
Organic Solvent Discharges

Only two solvents are used in appreciable amounts by GAD. These are acetone and ethyl acetate. An inventory of miscellaneous solvents for use in certain analytical procedures is also maintained. Many of these are infrequently used; however, their usage is estimated in the following table:

<u>SOLVENT</u>	<u>MAXIMUM DAILY DISCHARGE (liters)</u>	<u>YEARLY DISCHARGE (liters)</u>
Acetone	1	54
Ethyl Acetate	1	100
Miscellaneous	1	50

APPENDIX 3.10

Photochemicals Presently Used In GJO Photographic Laboratory

Chemical: DuPont Cronaflex Processor Developer Concentrate
Quantity: 250 gal./year
Disposal: To drain after use

Chemical: DuPont Cronaflex Processor Fixer Concentrate
Quantity: 250 gal./year
Disposal: 1) Desilvering via electrostatic silver recovery unit
2) Then to drain

Chemicals: Kodak Process E-6
1) First developer
2) Reversal bath
3) Color developer replenisher
4) Conditioner
5) Bleach
6) Fixer
7) Stabilizer
Quantity: 30 gal./each year (projected)
Disposal: To drain after use

Chemical: Kodak Ektaflo Developer Type 1
Quantity: 20 gal./year
Disposal: To drain after use

Chemical: Kodak Indicator Stop Bath
Quantity: 2 gal./year
Disposal: To drain after use

(Continued next page)

Appendix 3.10 (continued)

Chemical: Kodak Rapid Fixer (liquid) A+B
Quantity: 10 gal./year
Disposal: 1) Disilvering via electrostatic silver recovery unit
2) Then to drain

Chemical: Kodalith RT Liquid Developer A+B
Quantity: 10 gal./year (projected)
Disposal: To drain after use

Miscellaneous chemicals used in quantities less than 1 gal./year:

Kodak Sepia Toner
Kodak Farmer's Reducer
Kodak D-11 Developer

Disposal: To drain after use

THE MONTICELLO, UTAH, DOE FACILITY

1.0 Site Environment

1.1 Facility Description and History

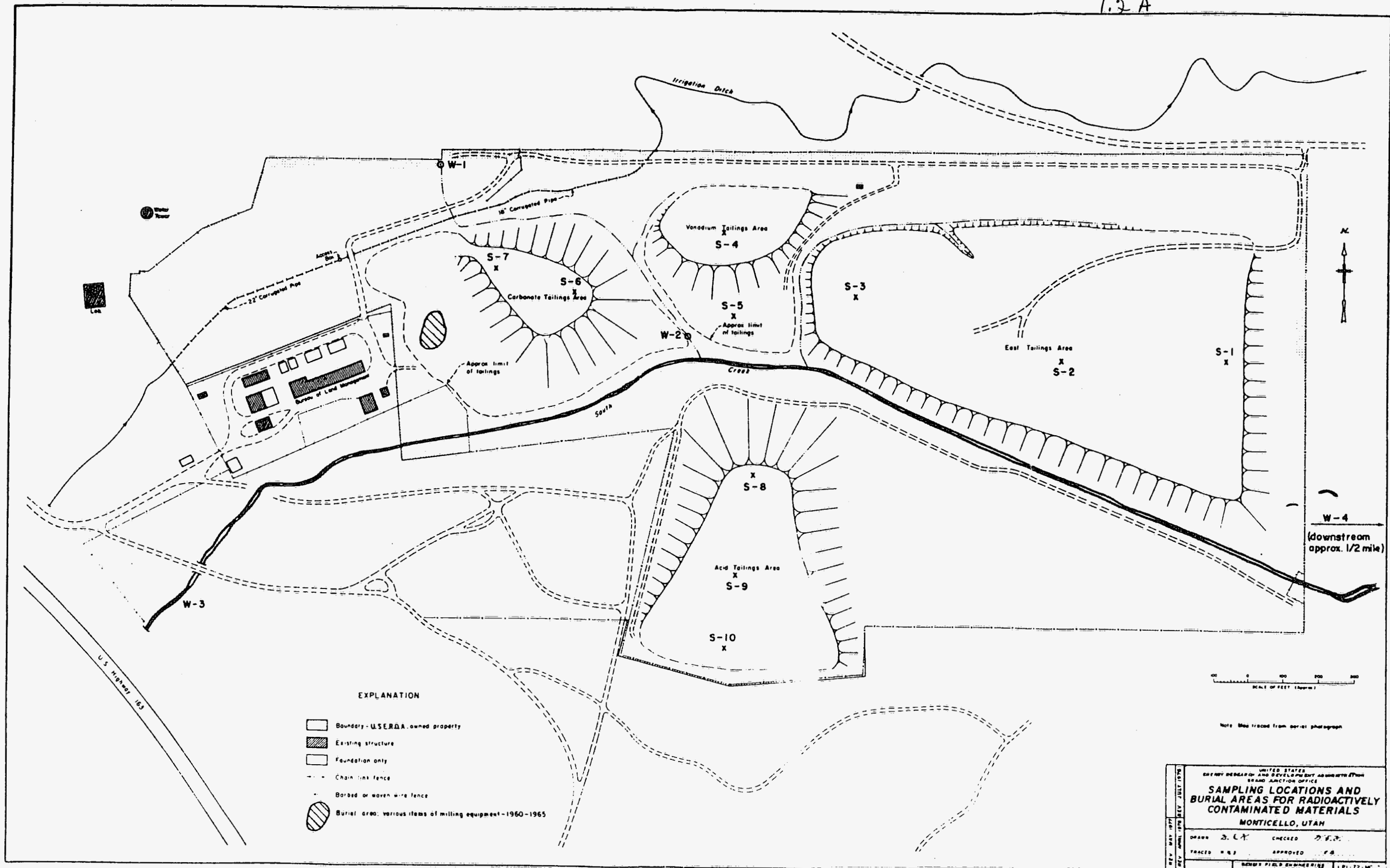
The Department of Energy site at Monticello, Utah was formerly a government owned uranium processing mill located near the south edge of the town of Monticello, Utah. The mill was operated for production of vanadium during the period 1942 to 1944, then taken over by the Atomic Energy Commission in 1948 and operated from 1949 until January, 1960, for the recovery of uranium. The site includes approximately 900,000 tons of radioactive tailing solids impounded in four separate tailings ponds, covering an aggregate area of approximately 40 acres.

During the life of the Monticello Mill, a number of techniques for uranium recovery were practiced. Initial recovery was by a system of roasting and carbonate leach process. In November, 1955, an acid leach resin-in-pulp (RIP) process was initiated. The system was then reconverted to a carbonate process. Tailings dams were of the self-constructing variety, resulting in a dam composed of coarse sand, with fine slimes located in the middle of a pond area. The various types of resultant tailings material are shown on the facility map (page 14). The origin of the tailings material is of importance in environmental consideration, since the various systems of uranium recovery tend to mobilize different toxic and radiochemical materials.

1.2 Site Geology

The Monticello facility site is underlain by the gently east dipping shales and sandstones of the Morrison and Dakota formations, with some Mancos shale outcrops of higher sections. South Creek has cut a valley in the Morrison, Dakota, and Mancos which has subsequently been filled with alluvium and colluvium from slope wash. These materials have variable permeability depending upon their lithology. Hence, movement of subsurface water could be expected to be highly variable, again depending upon the lithology.

Sit. Map
1.2 A



See attached map

Figure 2

1.3 Site Hydrology

The hydrology of the Monticello site is greatly influenced by runoff from the Abajo Mountains to the west, down the channel of South Creek, and in the form of groundwater underflow in the geologic formations which outcrop to the west and dip toward the east.

The flow in South Creek is in two modes: spring runoff due to snow melt in the Abajo Mountains and intense but short-lived runoff events associated with summer thunderstorms upon the mountain flanks. The former type of flow constitutes the major amount of runoff, but summer thunderstorms can be important due to their destructive erosional nature.

Most groundwater pumped from the Monticello site is from deep wells penetrating sandstones of the Morrison of older geological formations, such as the Entrada sandstone. Such water is frequently under artesian head due to outcrop of the aquifers along the flank of the Abajo Mountains.

1.4 Previous Environmental Degradation

During and shortly after the operation of the Monticello site, there was significant environmental degradation in South Creek. This degradation was documented by sampling conducted by the Atomic Energy Commission and the U. S. Public Health Service. Radium and uranium levels in South Creek were at or above allowable limits. There was also an indication of groundwater contamination in the area downgradient (east) of the site. This was most noted in the case of the "Sorensen" well, a shallow irrigation and stock water supply located approximately 1/2 mile east of the site. This contamination may have resulted from the subsurface movement of radium-bearing liquid waste from the tailings ponds through the alluvium along South Creek into the well. Other possible sources of the well contamination include movement of dredged solids into the well. Other forms of environmental degradation included wind and water erosion of tailing solids into South Creek and subsequent leaching of radionuclides from these materials and elevated external gamma radiation due to the surface presence of radioactive tailings solids.

1.5 Site Reclamation

In an effort to control the environmental degradation resulting from the tailings pile wind and water erosion, the U. S. Atomic Energy Commission conducted a site reclamation project at the Monticello facility during the period beginning in August, 1961. This action was a part of the Federal-State inter-agency pollution control effort on the Colorado River Basin. The restoration required 80 working days and an expenditure of \$190,000. Details of the project are contained in "A Report of the Monticello Mill Tailings Erosion Control Project, Monticello, Utah", prepared December 20, 1963, by the Grand Junction office of the U. S. Atomic Energy Commission. During the project, coarse sand tailings were added to the slime portions of the tailings ponds, and allowed to form a more firm base. The pond surfaces were then graded and leveled and 8-12 inches of pit-run rock and dirt plus topsoil was added to the surface. Various grass seeds were then added to the pile surface, and fertilized with barnyard manure and chemical fertilizer. This resulted in an external gamma radiation reduction of approximately one order of magnitude. Significant reductions in radium concentration within South Creek were also noted.

Subsequent to the tailings pile stabilization, the channel of South Creek was improved and riprapped to prevent erosion at the toe of the tailings piles.

Additional remedial measures were conducted* between May, 1974, and August, 1975, during which time the mill foundations were broken up and buried, and topsoil contaminated by ore stockpiling was excavated from two sites and placed on the top of the east tailings pile.

*Ward, D. L., and Gisler, W. D., "Uranium Ore Stockpile Site Decontamination and Mill Site Foundation Removal, Monticello, Utah." Bendix Field Engineering Corporation, Grand Junction, Colorado, BFEC-1976-7 (June 1976).

1.6 Existing Site Conditions

While the efforts at site reclamation have done much to minimize the environmental effects of the Monticello facility, there are some aspects of the facility which are still causing environmental degradation. The initial reclamation was the first effort at stabilizing a tailings pile, and it added much to the state of the art. On the other hand, there have been significant developments since the 1961 stabilization, which was originally intended as an interim measure. Conditions which can cause continuing site degradation are discussed in the following section, abstracted from field notes taken during an inspection of the Monticello facility on May 17, 1978.

The diversion ditch along the north side of the Carbonate Pile downstream of sampling point W-1 is in good shape and would be capable of carrying reasonably expected flows. Fairly good grass cover is established on the soil covering over the carbonate tailings area, with no significant evidence of gullying or erosion. There are sites at which tailings have been brought to the surface apparently by burrowing animals.

There is an existing deep observation well located on the east side of the carbonate tailings area between sampling sites S-6 and S-4, approximately 25 feet west of the intersection of the two streams draining between the carbonate and vanadium tailings area. This well contains water, and could be used for obtaining water level measurements and possible pumping for a groundwater sample.

Grass coverage on the vanadium tailings pile is better than that on the carbonate tailings area. The drainage ditch banks along the north side of the vanadium tailings pile, carrying a stream of water from the north, have been trampled down by cattle or other animals until the ditch has little carrying capacity over that required for the existing flow. The ditch discharges through a culvert along the north side of the vanadium pile. A series of seeps have formed along the southeast side of the vanadium tailings pile. Soil moisture also is evident in the area along an approximately east-west line in the vicinity of site S-5. It appears that water could be recharging into the groundwater body from the small diversion ditch on the north side of the vanadium pile, moving through the pile, and surfacing on the southeast side of the pile.

A small delta has formed where the drainage ditch flows to the south between the vanadium and east tailings area, with the result that the diversion ditch draining west along the north side of the east tailings area have been partially impounded, permitting a significant amount of runoff to infiltrate and subsequently move through the tailings.

Most of the east tailings pile has rather good vegetative cover, but there is a small higher portion of the east tailings pile which has almost no vegetative cover except a low, moss-like plant material, with evidence of thistles having grown in previous years. This zone resulted from cleanup of ore storage sites during the 1974-1976 decontamination, and should soon be covered with native vegetation.

Water has impounded on the lower portion of the east tailings pile to the north of the higher area. This would permit infiltration and leaching of radionuclides and toxics from the contained tailings pond.

A seep area exists on the northeast side of the east tailings pond, in the diversion ditch along the north side of the pond. This indicates that the groundwater is moving laterally to the south towards South Creek, through the tailings contained in the east pile. This could be eliminated by a deepening of the diversion ditch into impermeable material or by construction of pumped wells in the site. The amount of water produced does not appear to be large, probably in the neighborhood of 2-3 gallons per minute. It could be handled by a small infiltration gallery type well development. The source of the water appears to be infiltration from a small irrigation ditch north of the site.

There has been a significant amount of burrowing activity by small animals along the northeast side of the east tailings pile. This has resulted in the transport of tailing sands to the surface for subsequent erosion by wind or water. Similar burrowing activity has taken place along the south side of the east tailings pile.

South Creek has been contained in a riprapped channel through the tailings ponds. No evidence of significant channel erosion was noted. The channel appears adequate for reasonably expected flows. The stream flow was approximately 10 cubic feet per second at the time of site visit.

The acid tailings area, south of South Creek, would be expected to contain the most readily mobilized radionuclides, due to the acid processing. A road cut has been constructed along the northwest corner of this pile, which has exposed a salt crust formed by capillary moisture moving through the tailings and to the surface. This material would be available for erosion by precipitation events. The northwest side of the acid tailings pile is bounded by a small dike, which serves to channel runoff along the toe of the tailings pile. Vegetative cover on the acid tailings pile is quite well established and appears to be thriving.

There is a small holding pond located on the east flank of the acid tailings pond. At the southwest corner of this small holding pond, there is a large seep area, approximately 50 feet in diameter, which is extremely soft. It appears that this seep may be related to the former decant structure for the acid tailings pond, which may have been plugged and/or destroyed near the mouth, but which is still in existence within the pond area. This structure could serve as a groundwater drain for moisture moving through the tailings within the acid pile.

2. Continuing Environmental Effects

While the previous site reclamation efforts have done much to minimize environmental degradation from the Monticello facility, there are minor continuing environmental effects which should be considered in planning for ultimate site stabilization.

2.1 Air Effects

The primary air concern associated with the Monticello facility would be the continuing emanation of radon and its decay products from the pile. Radon gas, while heavier than air, has the unique ability to permeate through virtually any material.

The existing pile was covered with approximately 8-12 inches of sandy material, which offers little control over emanations of radon gas. This further is compounded by the fact that the burrowing animals penetrate the cover, by the thinning of the cover due to wind and water erosion, and by natural pile "breathing" during periods of atmospheric pressure change.

Radon measurements were performed over a one-year period in 1967 and 1968. It was concluded that the tailings "do not significantly affect the environmental radon levels away from the tailings area". Radon emanations from the Monticello facility are especially critical in view of the presence of nearby human habitation within the town of Monticello to the north, and in the suburban area along South Creek to the east.

2.2 Water Effects

The Monticello facility also has continuing environmental effects on the water resources of the area, primarily through the release of radium and toxic heavy metals, both to the ground and surface water.

2.2.1 Surface Water

The effects on surface water result both from groundwater infiltration to the surface streams, to be discussed in a subsequent section, and from sheet runoff conveying tailing solids which have been brought to the pile surface by burrowing animals. These tailing solids are subject to subsequent leaching in South Creek.

While the data following do not indicate violation of applicable radiochemical or toxic standards, there is a definite increase of uranium and radium in South Creek as a result of this facility.

RESULTS OF SOUTH CREEK DOE MONITORING

<u>Date</u>	<u>Concentration Upstream</u>			<u>Concentration Downstream</u>		
	<u>U₃O₈</u> <u>mp/l</u>	<u>Dissolved</u> <u>Ra 226</u> <u>pCi/l</u>	<u>Suspended</u> <u>Ra 226</u> <u>pCi/l</u>	<u>U₃O₈</u> <u>mg/l</u>	<u>Dissolved</u> <u>Ra 226</u> <u>pCi/l</u>	<u>Suspended</u> <u>Ra 226</u> <u>pCi/l</u>
11/25/75	1	0.005	0.005	21	0.005	0.005
06/21/76	2	0.2	2.6	375	1.0	0
12/08/76	2	0.17	0.45	457	0.57	0.69
06/22/77	2	0.005	0.005	22	0.005	0.005
11/09/77	21	0.3	0.1	13	0.3	0.3
05/18/78	5	0.5 \pm 1.9	0.0 \pm 1.8	13	0.0 \pm 1.4	0.9 \pm 1.8
06/07/79	1	0.0 \pm 4.5	0.0 \pm 4.2	10	0.0 \pm 3.8	0.0 \pm 5.5
08/30/79	1	1.7 \pm 1.2	0.4 \pm 0.5	100	0.4 \pm 0.6	0.3 \pm 0.5

U. S. Department of Health, Education, and Welfare, Evaluation of Radon-222 near Uranium Tailings Piles. USPHS, Bureau of Radiological Health, DER 69-1. Rockville, Maryland (March 1969).

2.2.2 Groundwater

Groundwater in the near surface material moves through the tailings, with the potential for leaching radionuclides, toxics, and heavy metals. Recharge for this groundwater occurs in response to precipitation infiltration on the pond surface, infiltration of ponded runoff in the diversion ditches in those areas where the ditches have been restricted by vegetation or by deposition of eroded solids, and by infiltration of water from the irrigation ditch which flows to the north of the facility. This water moves through the tailings and discharges either directly to South Creek as groundwater outflow or in the form of seeps, especially along the south edge of the vanadium tails.

In addition, salt crusts form where capillary moisture brings radionuclides and toxics to the land surface. Such crusts are available for subsequent dissolution and transport during precipitation events.

2.3 Wind and Water Erosion

For the most part, vegetative cover has become fairly well established on the pile surface, with the resultant reduction in wind and water erosion of the tailing solids. However, continuing problems with burrowing animals result in a movement of tailing solids through the soil cover for subsequent erosion. In addition, the thin veneer of cover cannot be considered as a permanent barrier for wind and water erosion over future centuries. The piles are topographically high features and will, over succeeding centuries, be attacked by erosional forces, which ultimately would lead to breaching and movement of the tailings into the environment, unless the continuing program of maintenance is enhanced.

2.4 Improvement Programs

Work has begun through the DOE Surplus Facilities Management Program to initiate final decontamination and decommissioning of the Monticello site. Significant accomplishments of this program will be summarized in future environmental monitoring reports.